इंटरनेट मानक

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“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

क्षैतिज तर्कु वाली बेधन और मिलिंग मशीनों के परीक्षण चार्ट

भाग 2 फर्श के स्तर की मशीनें

Indian Standard

TEST CHART FOR BORING AND MILLING MACHINES WITH HORIZONTAL SPINDLE

PART 2 FLOOR TYPE MACHINES

UDC 621·914·4 : 620·1 (084·3)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 1992

Price Group 10

Machine Tool Basics and Modular Units Sectional Committee, PE 03

NATIONAL FOREWORD

This Indian Standard which is identical with ISO 3070 - 2 : 1978 'Test conditions for boring and milling machines with horizontal spindle — Testing of accuracy : Part 2 Floor type machines' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendations of the Machine Tool Basics and Modular Units Sectional Committee (PE 03) and approval of the Production Engineering Division Council.

Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use point (.) as the decimal marker.

c) Some dimensions appears in 'inches' in the International Standard besides in metric systems, while in Indian Standards, the current practice is to give metric values only.

In the adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Correspondence*
ISO 230-1 : 1986	IS 2063 : 1988 Acceptance code for machine tools: Geometric accuracy of machines operating under no load or finishing conditions (*first revision*)	Identical
ISO/R 1101 : 1983	IS 8000 (Part 1) : 1985 Geometrical tolerancing on technical drawing: Part 1 Tolerancing of form, orientation location and run-out, and appropriate geometrical definitions (*first revision*)	Identical
ISO 3070-0 : 1982	IS 11958 (Part 0) : 1992 Test chart for boring and milling machines with horizontal spindle : Part 0 General introduction	Identical
ISO 3070-1 : 1987	IS 11958 (Part 1) : 1987 Test chart for boring and milling machines with horizontal spindle: Part 1 Table type machines	Equivalent

The concerned technical committee has reviewed the provisions of ISO 841-1974 'Numerical control of machines — Axis and motion — Nomenclature' referred in this adopted standard and has decided that it is acceptable for use in conjunction with this standard.

Indian Standard

TEST CHART FOR BORING AND MILLING MACHINES WITH HORIZONTAL SPINDLE

PART 2 FLOOR TYPE MACHINES

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies, with reference to ISO/R 230, both geometrical and practical tests on general purpose and normal accuracy boring and milling machines with horizontal spindle – floor type machines – and the corresponding permissible deviations which apply.

These machines can be provided with spindle heads of different types corresponding in most cases to figures :

4 (spindle head with milling spindle and boring spindle)

5 (spindle head with sliding boring spindle and with facing head)

6 (spindle head with ram or milling arm)

of Part 0 : "General introduction" of ISO 3070.

It must be made clear that this International Standard concerns machines which have both a transverse movement of the column on the bed, a vertical movement of the spindle head, an axial movement of the boring spindle and possibly a feed movement of the radial facing slide in the facing head. They can be provided with a floor supporting workpieces but this device is not taken into consideration in this International Standard.

Some machines also have an intermediate saddle having slideways between bed and column to achieve additional longitudinal feed movement of the column parallel with the spindle axis.

This International Standard deals only with the verification of accuracy of the machine. It does not apply to the testing of the running of the machine (vibrations, abnormal noises, stick-slip motion of components, etc.) or to machine characteristics (such as speeds, feeds, etc.) which should generally be checked before testing accuracy.

2 PRELIMINARY REMARKS

2.1 In this International Standard, deviations and ranges are expressed in millimetres and in inches.

2.2 To apply this International Standard, reference should be made to ISO/R 230, especially for installation of the machine before testing, warming up of spindles or other moving parts, description of measuring methods and recommended accuracy of testing equipment.

2.3 Users of this International Standard are reminded that a movement is said to be longitudinal when it is parallel to the axis of the machine spindle and is said to be transversal when it is in the perpendicular direction.

2.4 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and this in no way defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be applied in any order.

2.5 When inspecting a machine, it is not always possible or necessary to carry out all the tests given in this International Standard. It is up to the user to choose, in agreement with the manufacturer, those tests relating to the properties which are of interest to him, but these tests are to be clearly stated when ordering a machine.

2.6 Practical tests should be made with finishing cuts.

2.7 When establishing the tolerance for a measuring range different from that given in this International Standard (see clause 2.311 in ISO/R 230) it should be taken into consideration that the minimum value of tolerance is 0,002 5 mm (0,000 1 in) for both geometrical and practical tests.

3 REFERENCES

ISO/R 230, *Machine tool test code.*

ISO 841, *Numerical control of machines – Axis and motion nomenclature.*

ISO 3070/0, *Test conditions for boring and milling machines with horizontal spindle – Testing of the accuracy – Part 0 : General introduction.*

ISO 3070/I, *Test conditions for boring and milling machines with horizontal spindle – Testing of the accuracy – Part I : Table type machines* (and its addendum : *Complementary geometrical tests and practical test to be specified in the case of rotary table machines*).

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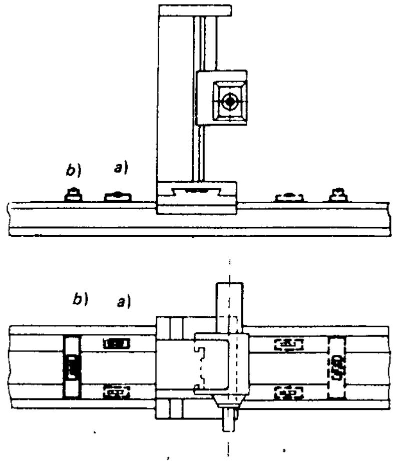
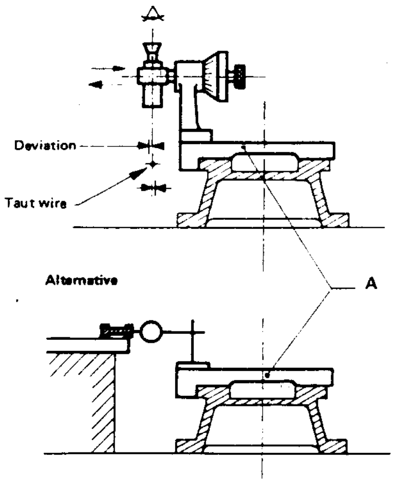
4 TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

4.1 Geometrical tests

No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 1		**A – BED** Verification of levelling of slideways : *a)* Checking of bed lengthwise : – straightness of slideways in the vertical plane;	*a)* 0,02 up to 1000 For each 1000 mm (40 in) increase in length add to the preceding tolerance : 0,01 Local tolerance : 0,006 over any measuring length of 300 Maximum permissible deviation : 0,05 up to 10000 0,08 above 10000	*a)* 0.0008 up to 40 0.0004 0.00025 12 0.002 up to 400 0.0032 above 400	Precision level, optical or other methods	*a)* Clauses 3.11, 3.21 and 5.212.21 or 5.212.22 – Measurements shall be made at a number of positions equally spaced along the length of the bed. – The column shall be placed in the middle of its traverse on the table saddle with the table saddle placed in the middle of the bed.
		b) Checking of bed crosswise : – slideways should be in the same plane.	*b)* Variation of level : 0,02/1000	0.0008/40	Precision level and support	*b)* Clause 5.412.7 A level shall be placed transversely and measurements taken at a number of positions equally spaced along the length of the bed. The variation of level at any position shall not exceed the permissible deviation.
G 2		Checking of straightness of the slideways in a horizontal plane.	0,02 up to 1000 For each 1000 mm (40 in) increase in length add to the preceding tolerance : 0,005 Local tolerance : 0,006 over any measuring length of 300 Maximum permissible deviation : 0,05 up to 10000 0,08 above 10000	0.0008 up to 40 0.0002 0.00025 12 0.002 up to 400 0.0032 above 400	Microscope and taut wire or other optical methods Dial gauge, straightedge and supports	Clauses 5.212.3 or 5.212.22 or 5.232.1 The microscope or the dial gauge shall be fixed on a support A of a suitable form such that it can slide in the slideways and shall sight or touch, in the horizontal plane, the taut wire or a straightedge laid parallel to the slideways. The taut wire or the straightedge shall be placed on a fixed part, independent of or integral with the machine and as near as possible to the slideways to be checked.

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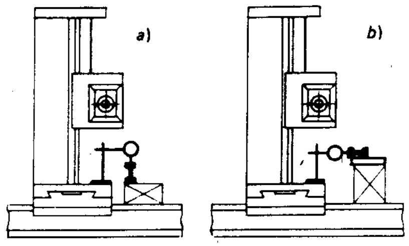
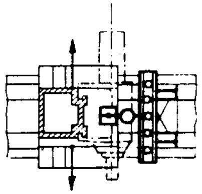
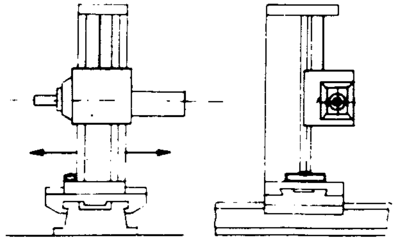
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 3	 	**B – COLUMN SADDLE** (In the case of columns provided with a saddle for movement of the column parallel to the spindle axis) Checking of the slideways between saddle and column : – straightness of movement of the column on the saddle. 1) **Longitudinal verification** (along the W axis) : *a*) in a vertical plane; *b*) in a horizontal plane.	For *a*) and *b*) 0,02 up to 1000 0,03 above 1000 Local tolerance : 0,006 over any measuring length of 300	 0.0008 up to 40 0.0012 above 40 0.00025 12	Dial gauge, straightedge and supports or optical methods	Clauses 5.232.1 or 5.212.22 The dial gauge shall be fixed on the column base such that it can slide against the functional part of a straightedge laid parallel to the saddle slideways. For checking *b*), the straightedge is laid horizontally and flat and for checking *a*), the straightedge is laid vertically on edge. The straightedge shall be placed on a fixed part, independent of or integral with the machine and as near as possible to the slideways to be checked.
		2) **Transverse verification** (along the X axis) : – slideways should be in the same plane.	Variation of level : 0,02/1000	 0.0008/40	Precision level	Clause 5.412.7 A level shall be placed transversely on the column base and measurements taken at a number of positions equally spaced along the length of the column. The variation of level measured at any position shall not exceed the permissible deviation.

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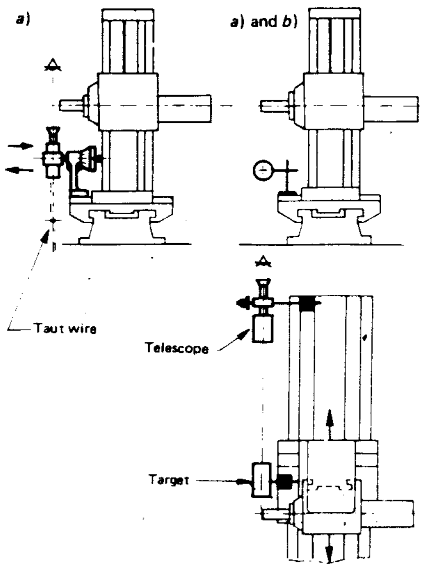
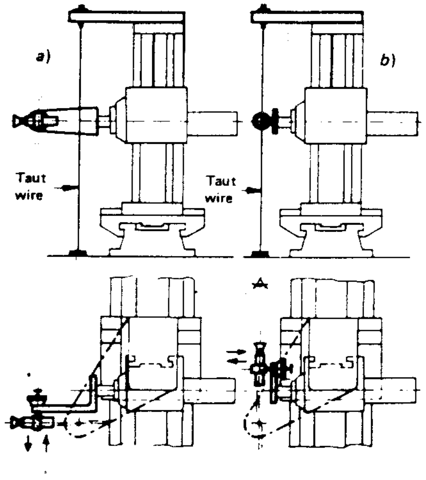
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 4		**C – COLUMN** Checking of straightness of the movement of the column lengthwise on the bed : *a)* in the horizontal plane; *b)* in the vertical plane.	For *a)* and *b)* 0,04 up to 1000 For each 1000 mm (40 in) increase in length, add to the preceding tolerance : 0,005 Maximum permissible deviation : 0,12	0.0016 up to 40 0.0002 0.005	Optical methods or microscope and taut wire	Clauses 5.212.22 or 5.212.3-5.232.2 For checking *b)* the telescope may be fixed on the machine or may be independent of the machine.
G 5		Checking of straightness of the vertical movement of the spindle head on the column : *a)* in the vertical plane coaxial with the spindle axis; *b)* in a vertical plane perpendicular to the spindle axis.	For *a)* and *b)* 0,02 up to 1000 For each 1000 mm (40 in) increase in length add to the preceding tolerance : 0,01 for machines having travel ⩽ 4000 mm (160 in) and : 0,02 for machines having travel > 4000 mm (160 in)	0.0008 up to 40 0.0004 0.0008	Microscope and taut wire or optical methods	Clauses 5.212.3-5.232.2 or 5.212.22 Carry out the test with saddle locked and possibly column base locked in mid-travel. Lock the spindle head when taking measurements. If the spindle can be locked, the alignment telescope can be mounted on it. If the spindle cannot be locked, the alignment telescope shall be placed on the spindle head of the machine. The taut wire shall be tightened between fixed parts independent of or integral with the machine.

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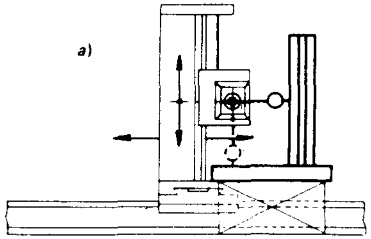
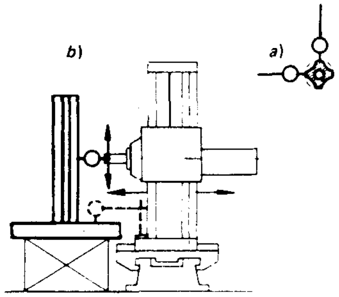
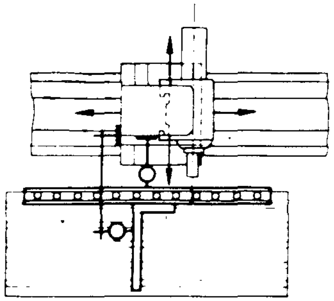
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 6	a) 	Checking of squareness of the vertical movement of the spindle head : a) to the transverse movement of the column (axis X) in a vertical plane perpendicular to the spindle axis;	a) 0,03/1000	a) 0.0012/40	Dial gauge, surface plate and square or optical methods	Clauses 5.522.4 or 5.212.22 For *a)* : place a surface plate on a support independent of the machine and as near as possible to the machine. The surface plate face shall be adjusted parallel to the transverse (axis X) movement of the column. For *b)* : the surface plate face shall be adjusted parallel to the longitudinal (axis W) movement of the column. Lock the column on the table saddle and lock the column saddle on the bed when taking measurements. Set a cylindrical square on the surface plate adjusted as indicated above. Lock the spindle head when taking measurements (spindle retracted). If the spindle can be locked, then the dial gauge may be mounted on it. If the spindle cannot be locked, the dial gauge shall be placed on the spindle head of the machine. NOTE – Operation G 6 *b)* is to be carried out only on machines provided with a longitudinal (axis W) movement of the column.
	b) 	*b)* to the longitudinal movement of the column (axis W) in the vertical plane coaxial with the spindle axis.	b) 0,03/1000	b) 0.0012/40		
G 7		Checking of squareness of the longitudinal (axis W) and transverse (axis X) movements of the column (if there is a column saddle).	0,03/1000	0.0012/40	Dial gauge and straightedge and square or optical methods	Clauses 5.522.4 and 5.212.22 Spindle head locked in mid-travel. The straightedge shall be set and fixed parallel to the transverse movement of the column and with the square against the straightedge. The saddle shall then be locked on the bed. The longitudinal movement of the column shall then be checked.

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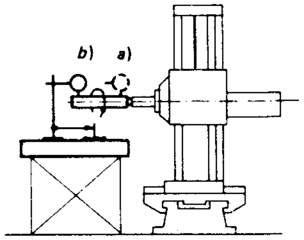
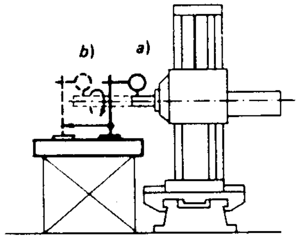
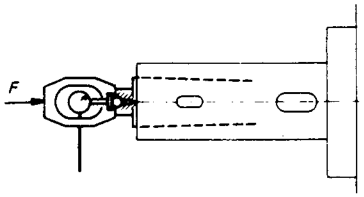
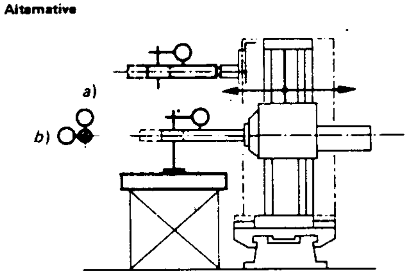
No.	Diagram	Object	Permissible deviation mm	Permissible deviation in	Measuring instruments	Observations and references to the test code ISO/R 230
G 8		**D – BORING SPINDLE** Measurement of run-out of the internal taper of the boring spindle : *a)* at the mouth of taper; *b)* at a distance of 300 mm (12 in) from the spindle nose.	For $D^* \leqslant 125$ *a)* 0,01 *b)* 0,02 For $D^* > 125$ *a)* 0,015 *b)* 0,03	For $D^* \leqslant 5$ *a)* 0.0004 *b)* 0.0008 For $D^* > 5$ *a)* 0.0006 *b)* 0.0012	Dial gauge, test mandrel and surface plate	Clause 5.612.3 Carry out measurements with the spindle retracted (sliding spindle). * D = diameter of boring spindle.
G 9		Measurement of run-out of the boring spindle : *a)* spindle retracted; *b)* spindle extended 300 mm (12 in) (sliding spindle)	For $D^* \leqslant 125$ *a)* 0,01 *b)* 0,02 For $D^* > 125$ *a)* 0,015 *b)* 0,03	For $D^* \leqslant 5$ *a)* 0.0004 *b)* 0.0008 For $D^* > 5$ *a)* 0.0006 *b)* 0.0012	Dial gauge and surface plate	Clause 5.612.2 * D = diameter of boring spindle.
G 10		Measurement of periodic axial slip of the boring spindle (spindle retracted).	For $D^* \leqslant 125$ 0,010 For $D^* > 125$ 0,015	For $D^* \leqslant 5$ 0.0004 For $D^* > 5$ 0.0006	Dial gauge	Clauses 5.622.1 and 5.622.2 Carry out this test with the spindle retracted (sliding spindle). The existence, value and the direction of application of the force F should be stated by the manufacturer. * D = diameter of boring spindle
G 11		Checking of parallelism of the boring spindle axis to the longitudinal movement of the column (axis W) on the slideways between column and saddle (if there is a column saddle) : *a)* in the vertical plane; *b)* in the horizontal plane.	*a)* 0,02 for a measuring length of 300 *b)* 0,02 for a measuring length of 300	*a)* 0.0008 12 *b)* 0.0008 12	Dial gauge and, possibly, test mandrel, and surface plate	Clauses 5.412.1 and 5.422.3 Spindle head locked in mid-travel, column saddle locked in mid-position on the bed. The measurement shall be carried out according to the possibilities, either touching directly the external part of the boring spindle, or with the aid of a test mandrel mounted in the spindle nose (alternative).

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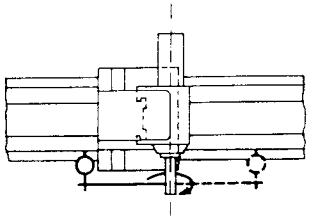
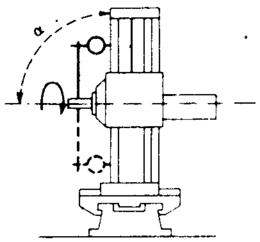
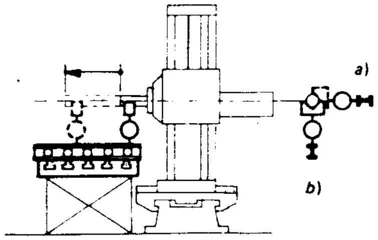
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 12		Checking of squareness of the boring spindle axis to the bed slideways.	0,03/1000*	0.0012/40*	Dial gauge and possibly straightedge	Clauses 5.512.1, 5.512.42 and 5.442 Column locked on the table, saddle locked in mid-position on the bed, spindle head locked in low position on the column, spindle and possibly ram retracted. For large machines for which sizes have a great importance the measuring reference shall be related to a plane parallel to the bed slideways. * Distance between the two points touched.
G 13		Checking of squareness of the boring spindle axis to the column ways.	0,03/1000 with α ⩽ 90°	0.0012/40* with α ⩽ 90°	Dial gauge and possibly straightedge	Clauses 5.512.1, 5.512.42 and 5.442 Spindle head locked in mid-travel on the column, spindle retracted. For spindle heads provided with a ram, the checking shall be carried out with the ram retracted. For large machines for which sizes have a great importance the measuring reference shall be related to a plane parallel to the column ways. * Distance between the two points touched.
G 14		Checking of straightness of the boring spindle movement (sliding spindle) : *a*) in a horizontal plane; *b*) in a vertical plane.	*a*) 0,02 for a measuring length of 300 *b*) 0,02 for a measuring length of 300	*a*) 0.0008 12 *b*) 0.0008 12	Straightedge and dial gauge	Clause 5.232.1 Spindle head locked. The straightedge shall be set parallel to the sliding spindle movement; then touch the functional surface of the straightedge with the stylus of a dial gauge fixed on the spindle nose. Repeat the same operations in the two planes : horizontal and vertical. In the case of a machine having a ram, it shall be maintained locked, in the retracted position.

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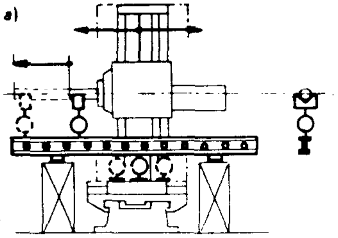
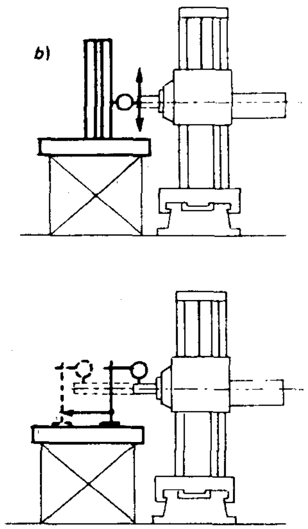
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 15	a) 	Measurement of deflection of the spindle in its sliding movement (axis Z) : a) [in the case of columns provided with a saddle for longitudinal movement (axis W)] in relation to a reference plane parallel to the plane of movement of the column on the saddle;	For an extension of the spindle equal to twice the spindle diameter : + 0,015 For an extension of the spindle equal to 4 times the spindle diameter : ± 0,02 For an extension of the spindle equal to 6 times the spindle diameter : − 0,06 NOTE – The extension of the spindle is limited to 6 times the spindle diameter and must not exceed 900 mm (36 in).	+ 0.0006 ± 0.0008 − 0.0024	Straightedge, gauge blocks and dial gauge	a) Align the straightedge in a horizontal plane parallel to the movement of the column on the saddle.
	b) 	b) [in the case of columns placed directly on the bed] in relation to a reference plane perpendicular to the vertical movement of the spindle head on the column.				b) Align the straightedge so that the vertical plane of a square laid on this straightedge is parallel to the guiding surface of the column ways and then, with the spindle retracted, incline the straightedge so that the upper part of the vertical side of the straightedge leans towards the column with an inclination of 0,006/300 mm (0.00024/12 in). NOTE – For a) and b), the measurements shall be carried out at positions corresponding to 2, 4 and 6 times the spindle diameter.

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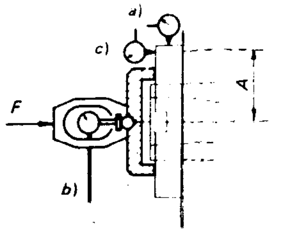
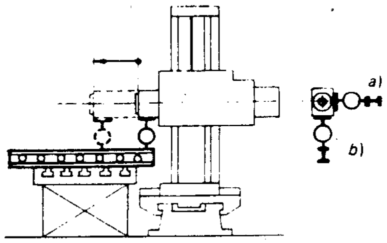
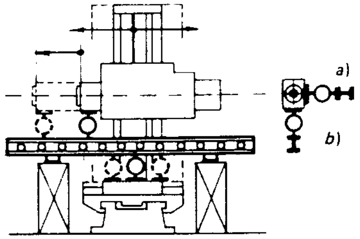
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 16		E — MILLING SPINDLE *a)* Measurement of run-out of the milling spindle; *b)* Measurement of periodic axial slip; *c)* Measurement of camming of the face of the spindle nose (including periodic axial slip).	For $D^* \leqslant 125$ *a)* 0,01 *b)* 0,01 *c)* 0,02 For $D^* > 125$ *a)* 0,015 *b)* 0,015 *c)* 0,03	For $D^* \leqslant 5$ *a)* 0.0004 *b)* 0.0004 *c)* 0.0008 For $D^* > 5$ *a)* 0.0006 *b)* 0.0006 *c)* 0.0012	Dial gauge	*a)* Clause 5.612.2 *b)* Clauses 5.622.1 and 5.622.2 The existence, value and direction of application of the force *F* shall be stated by the manufacturer. *c)* Clause 5.632 The distance *A* of dial gauge *c)* from the spindle axis shall be as large as possible. * *D* – diameter of boring spindle.
G 17		F — RAM Checking of straightness of the ram movement : *a)* in a horizontal plane; *b)* in a vertical plane.	*a)* 0,02 for a measuring length of 500 *b)* 0,02 for a measuring length of 500	*a)* 0.0008 20 *b)* 0.0008 20	Straightedge and dial gauge	Clause 5.232.1 Spindle head locked. Boring spindle retracted. Set the straightedge parallel to the ram movement; then touch the functional surface of the straightedge with the stylus of a dial gauge fixed at the end of the ram. Repeat the same operations in the two planes : horizontal and vertical.
G 18		Checking of parallelism of the ram movement (axis Z) to the longitudinal movement of the column (axis W) : *a)* in a horizontal plane; *b)* in a vertical plane.	For *a)* and *b)* 0,03 for a measuring length of 500	0.0012 20	Straightedge and dial gauge	Clause 5.422.5 A straightedge shall be set parallel to the longitudinal movement of the column (axis W) and then the column locked in the middle of its travel on its saddle. The ram movement shall then be checked with respect to the straightedge.

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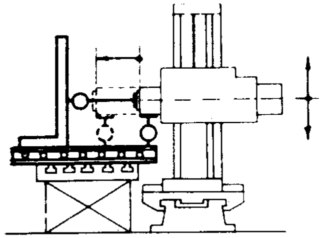
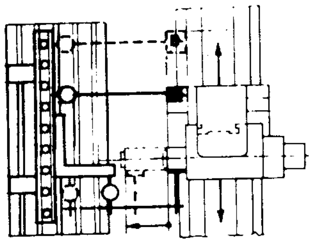
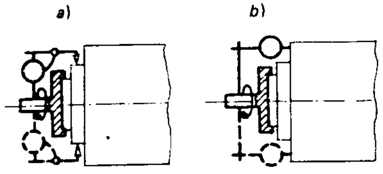
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 19		Checking of squareness of the longitudinal movement of the ram (axis Z) to the vertical movement of the spindle head on the column ways.	0,03/500	0.0012/20	Straightedge, square and dial gauge or optical methods	Clause 5.522.4 Place a straightedge on a table set parallel to the longitudinal movement of the ram (axis Z) in a vertical plane and place a square on the straightedge. *Alternative* : The surface plate used in test G 6 may be used for carrying out this test.
G 20		Checking of squareness of the ram longitudinal movement (axis Z) to the ram transverse movement (axis X) on the bed slideways.	0,05/1000	0.0020/40	Straightedge, square and dial gauge or optical methods	Clause 5.522.4 Place a straightedge on the table set parallel to the movement of the column on the bed (axis X) and place a square against the straightedge.
G 21		*a)* Checking of concentricity of the milling spindle and of the front centring of tools or accessories on the ram; *b)* Checking of squareness of the support surface of tools or accessories to the rotation axis of the milling surface.	*a)* 0,02 *b)* 0,02/500	*a)* 0.0008 *b)* 0.0008/20	Dial gauge	*a)* Clause 5.422 *b)* Clause 5.512.42 NOTE – This operation is valid only if there is a circular locating surface on the ram.

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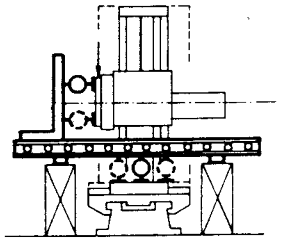
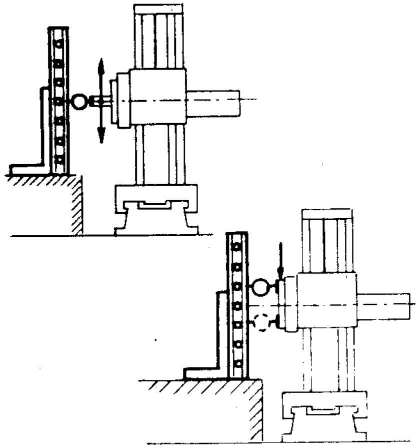
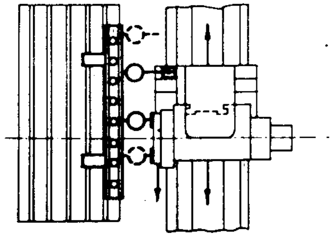
No.	Diagram	Object	Permissible deviation mm	Permissible deviation in	Measuring instruments	Observations and references to the test code ISO/R 230
G 22		**G – INTEGRAL FACING HEAD** **– radial facing slide –** Checking of squareness of the radial facing slide movement (axis U) to the longitudinal movement of the column (axis W);	0,025/300	0.001/12	Straightedge, square and dial gauge	Clauses 5.522.2 and 5.422.5 A straightedge or a surface plate shall be set parallel to the longitudinal movement of the column (axis W) or, where there is no such movement, parallel to the vertical movement of the spindle head. The column shall then be locked in the middle of its travel on its saddle. Place a square on the straightedge or on the surface plate. Then, check the radial facing slide movement. Repeat the same operation after rotation of the facing head by 180° NOTE – The surface plate used in test G 6 may be used for carrying out this test.
		or (if there is no column saddle) : Checking of parallelism of the radial facing slide movement (axis U) to the vertical movement of the spindle head.	0,025 for a measuring length of 300	0.001 12		
G 23		Checking of parallelism (in the horizontal plane) of the radial facing slide movement to the transverse movement of the column on the bed (axis X).	0,025 for a measuring length of 300	0.001 12	Straightedge and dial gauge	Clause 5.422.5 Set a straightedge on the table parallel to the transverse movement of the column on the bed (axis X). Then check the radial facing slide movement with respect to the straightedge. Repeat the same operation after rotation of the facing head by 180°.

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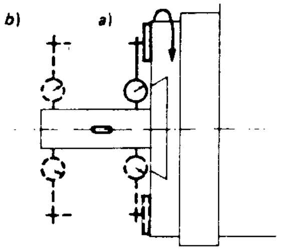
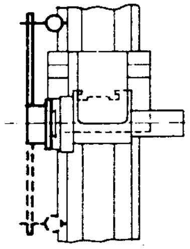
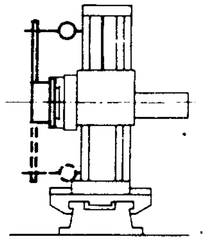
No.	Diagram	Object	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
			mm	in		
G 24		Checking of coaxiality of the boring spindle axis and of the facing head axis (in the case of independent movements of the boring spindle and of the facing head). *a)* at the mouth of spindle housing; *b)* at a distance from the spindle housing face equal to 300 mm (12 in).	For $D^* \leqslant 125$ *a)* 0,02 *b)* 0,03 For $D^* > 125$ *a)* 0,03 *b)* 0,04	For $D^* \leqslant 5$ *a)* 0.0008 *b)* 0.0012 For $D^* > 5$ *a)* 0.0012 *b)* 0.0016	Dial gauge	Clause 5.442 NOTE – This check is valid only if the facing head is mounted on bearings independent of those of the boring spindle. * D = diameter of boring spindle.
G 25		Checking of squareness of the facing head axis to the bed slideways.	0,03/1000*	0.0012/40*	Dial gauge and rigid support and, possibly, a straightedge	Clauses 5.512.1, 5.512.42 and 5.442 Column locked on the saddle and in mid-position on the bed; spindle head locked in low position on the column. For large machines for which sizes have a great importance the measuring reference shall be related to a plane parallel to the bed slideways. NOTE – This check is valid only if the facing head is mounted on bearings independent of those of the boring spindle. * Distance between the two points touched.
G 26		Checking of squareness of the facing head axis to the column ways.	0,03/1000*	0.0012/40*	Dial gauge and rigid support and, possibly, a straightedge	Clauses 5.512.1, 5.512.42 and 5.442 Column locked on the saddle, spindle head locked in mid-position on the column. For a large machines for which sizes have a great importance the measuring reference shall be related to a plane parallel to the column slideways. NOTE – This check is valid only if the facing head is mounted on bearings independent of those of the boring spindle. * Distance between the two points touched.

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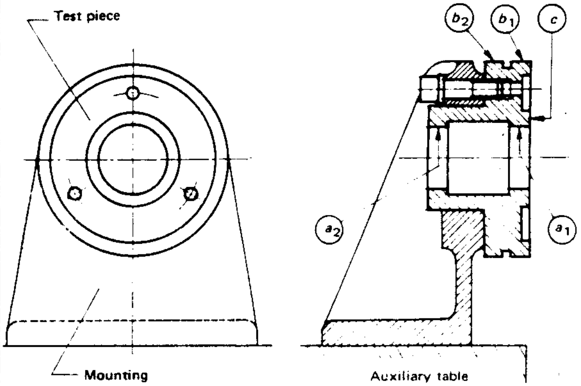
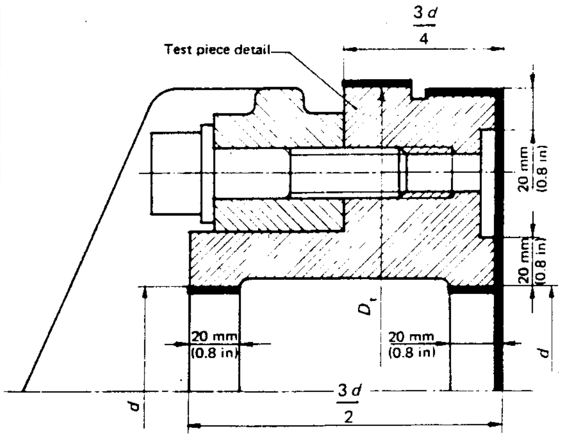
4.2 Practical tests

Diagram, sizes and mounting of the test piece (given only as an example)	Nature of test	Checks to be applied		Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
		No.	Designation	mm	in		
1) BORING, TURNING AND FACING*  Test piece b_2 b_1 c a_2 a_1 Mounting Auxiliary table  $\frac{3d}{4}$ Test piece detail 20 mm (0.8 in) 20 mm (0.8 in) D_t d 20 mm (0.8 in) 20 mm (0.8 in) d $\frac{3d}{2}$ NOTES 1 The boring diameter d shall be at least equal to, or slightly greater than, the boring spindle diameter. 2 The turned diameter D_t shall be determined so that the value $\frac{D_t - d}{2}$ is slightly less than, or at most equal to, the maximum travel of the radial facing slide. 3 Test piece material : Cast iron (CG-8).	Machining of a single test piece. Boring of the internal cylindrical holes a_1 and a_2. Turning of the external cylindrical surfaces b_1 and b_2. Facing of the surface c.	P 1	CIRCULARITY (Clause 5.3 of ISO/R 1101) of the internal cylindrical holes a_1 and a_2 and of the external cylindrical surface b_1	For a_1 and a_2 : $d \leqslant 125$: 0,0075 $d > 125$: 0,010 For b_1 : $D_t \leqslant 300$: 0,010 $D_t > 300$: 0,010 For each 300 mm increase add 0,015	 $d \leqslant 5$: 0.0003 $d > 5$: 0.0004 $D_t \leqslant 12$: 0.0004 $D_t > 12$: 0.0004 For each 12 in increase add 0.0006	Bore gauge and micrometer or measuring instruments having the appropriate accuracy	* This test only applies to machines having both a sliding boring spindle and an integral facing head, or an independent milling spindle. Clauses 3.1 and 3.22 4.1 and 4.2 5.442, 5.512.42 and 5.611.3 Before commencing the tests make sure that the mounting surface which bears on the table is flat and that the test piece surface which bears on the mounting is perpendicular to the axis of its housing.
		P 2	CYLINDRICITY (Clause 5.4 of ISO/R 1101) of the internal cylindrical holes a_1 and a_2	$d \leqslant 125$: 0,010 $d > 125$: 0,015	$d \leqslant 5$: 0.0004 $d > 5$: 0.0006		
		P 3	CONCENTRICITY (Clause 5.11.1 of ISO/R 1101) of the internal cylindrical hole a_1 and of the external cylindrical surface b_1	0,025	0.001	Mandrel and dial gauge	**DIRECTIONS FOR MACHINING** 1) Boring and finishing of the two internal cylindrical holes a_1 and a_2. Column locked and axial movement of the sliding boring slide. 2) Turning of the external cylindrical surface b_1. With a short tool mounted on the facing head with longitudinal movement of the column (axis W). 3) Longitudinal movement of the column of 300 mm (12 in) and turning of the external cylindrical surface b_2. Tool mounted on a surfacing head, with the aid of a support or a tool holder having a suitable length. 4) Machining of the face c by automatic movement of the radial facing slide or by milling.
		P 4	COAXIALITY (Clause 5.11.2 of ISO/R 1101) of the external cylindrical surfaces b_1 and b_2 with the reference axis of the internal cylindrical holes a_1 and a_2	0,04 for a longitudinal movement of the column saddle (or if there is no saddle, of the ram) equal to 300	0.0016 equal to 12	Mandrel and dial gauge	
		P 5	FLATNESS (Clause 5.2 of ISO/R 1101) of the machined surface c	0,015 for a diameter D_t of 300	0.0006 12	Straightedge and gauge blocks	
		P 6	PERPENDICULARITY (Clause 5.8.2 of ISO/R 1101) of the machined face c with the reference axis of the internal cylindrical holes a_1 and a_2	0,025/300	0.001/12	Mandrel and dial gauge or level and special support	

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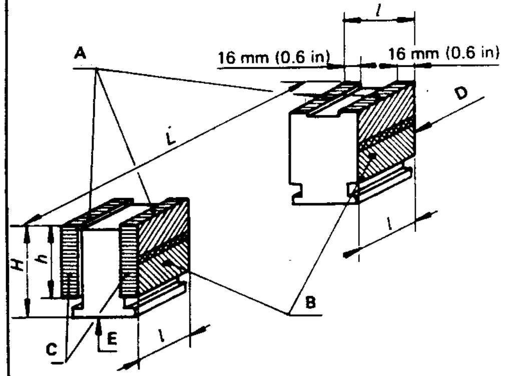
4.2 Practical tests *(continuation and end)*

No.	Diagram and dimensions of the test pieces	Nature of test	Cutting conditions	Checks to be applied	Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
					mm	in		
P 7	2 MILLING OF TWO SYMMETRICAL TEST PIECES  l A 16 mm (0.6 in) 16 mm (0.6 in) D L H h B C E l l	Milling of strips of surfaces A, C and D by automatic transverse movement of the column, automatic transverse movement of the spindle head and manual longitudinal movement of the column.	With a shell end mill, mounted at the end of the spindle on a mandrel of a suitable length					Clauses3.1 and 3.22 4.1 and 4.2 Before beginning the test : – make sure that surface E is flat; – check and suitably adjust the surface of the auxiliary table so that it is parallel to the longitudinal and transverse movement of the column. Test pieces shall be aligned parallel to the direction of the transverse movement of the column so that the length *L* is equally distributed on either side of the transverse median plane of the bed. NOTE – Subject to agreement between the user and the manufacturer, the form of test piece shown in the diagram may be replaced by a simpler form of test piece having sides of full width, in which case tests carried out using this form will be at least as severe as those carried out using the form in the diagram.
	L (distance between the opposite faces of two test pieces) = 1/2 longitudinal travel of the column $l = h =$ 150 mm (6 in) for $L \leqslant$ 1 000 mm (40 in) = 200 mm (8 in) for $L >$ 1000 mm (40 in) **Material : Cast iron.**	Milling of surface B by automatic transverse movement of the column and manual vertical movement of the spindle head in two cuts overlapping by about 5 to 10 mm (0.2 to 0.4 in).	Slab milling with the same cutter	Surface B on each block shall be flat.	0,02	0.0008	Straightedge and gauge blocks or micrometer callipers	The cutter shall be sharpened on its arbor and when mounted shall conform to the following tolerances : 1 Out of round $\leqslant$ 0,01 mm (0.0004 in) 2 Run-out $\leqslant$ 0,02 mm (0.0008 in) 3 Camming $\leqslant$ 0,03 mm (0.0012 in) All non-operating slides shall be locked during cutting.
				a) The planes containing the strips of surfaces A, C and D shall be perpendicular to each other and each one perpendicular to the surface B.	0,02/100	0.0008/4	Square and gauge blocks	
				b) The height *H* of the block (or blocks) shall be constant.	0,03	0.0012	Micrometer	

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